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(54) IMAGE PROCESSOR

(57)Abstract:
PROBLEM TO BE SOLVED: To solve such problems of conventional television and movie production that 'wrinkes' of a human's skin part can not be emphasized (aging representation) and a 'complextion' can not be made better (representation of restoration of youth) without spoiling the fineness or texture of skin.
SOLUTION: A specific amplitude band variation component separate type digital filter (β filter) is constituted which newly has a specific amplitude band variation component calculation part 4 so as to actualize a 'wgood complextion' and 'wrinkle emphasis' with a natural feeling holding, for example, the fineness and texture of skin, a calculation part 4 selectively separates only a specific amplitude band variation component U (m, n) from an input image signal X (m, n) applied to this filter and outputs an image signal (m, n) generated by subtracting ('good complexion') the component from the input image signal or adds ('wrinkle emphasis') to the input signal according to an external

correction indication.

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]While being an image processing device which performs formation of a "skin vine", or "wrinkles" emphasis and impressing an input picture signal to an input terminal of epsilon-filter to an inputted image, A signal with which "wrinkles emphasis" of the input picture signal acquired by adding an output signal of a small-size width fluctuation-components calculation part of the epsilon-filter concerned to said input picture signal was carried out, An image processing device, wherein a signal with which an input picture signal which is an output signal of the aforementioned epsilon-filter "skin vine" Turned constitutes as an alternative or an extended epsilon-filter which is taken out simultaneously.
[Claim 2]While being impressed by each input terminal of two epsilon-filters which have epsilon value which differs in size an input picture signal, size -- an output signal of epsilon-filter of epsilon value -- smallness -- an image processing device constituting so that an input picture signal may be taken out as a signal which left texture and textures of skin and "skin vine" turned by adding an output signal of a small-size width fluctuation-components calculation part of epsilon-filter of epsilon value.
[Claim 3]an input picture signal -- size -- an extended epsilon-filter which has epsilon value -- smallness, while being impressed by each input terminal of epsilon-filter which has epsilon value, When correction instruction is "skin vine"-ization, by adding an output signal of a small-size width fluctuation-components calculation part of the aforementioned epsilon-filter to a "skin vine"-ized output signal of said extended epsilon-filter, "Skin vine" An input picture signal leaves texture and textures of skin, and them When correction instruction as a signal which turned is "wrinkles emphasis", By subtracting an output signal of a small-size width fluctuation-components

calculation part of the aforementioned epsilon-filter from a "wrinkles emphasis" output signal of said extended epsilon-filter, An image processing device constituting so that it may be taken out, respectively as a signal "wrinkles emphasis" was carried out by input picture signal maintaining the original state of texture of skin.

[Claim 4]By using arbitrarily a specific amplitude belt fluctuation-components discrete type digital filter (beta-filter) which separates selectively only fluctuation components which have the amplitude value inserted into the two amplitude value concerned by making into a parameter amplitude value of two size which can be set up, An image processing device with which a signal which an input picture signal left texture and textures of skin, and "skin vine" Turned, and a signal "wrinkles emphasis" was carried out by input picture signal maintaining the original state of texture of skin are characterized by an alternative or constituting so that it may be taken out simultaneously.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]this invention relates to image processing and contents and expressions, such as a teleplay and a movie, are especially related with the image processing device aiming at so to speak acquiring the quality picture in the field as which advanced work nature is required which has natural feeling from expansion of the application range from a viewpoint of use as an "electronic makeup" device.

[0002]

[Description of the Prior Art]It is two-dimensional epsilon to the picture which photographed people's face, a head, a hand, etc. - Filter.(For example, J65-A, No.4, "epsilon-separation nonlinear digital filter and its application" Institute of Electronics and Communication Engineers 1982.4, and pp297-304 besides Harashima Reference) By applying. The picture of the "skin vine vine" by which wrinkles and silverfish were removed or reduced is acquired (Arakawa others). "Removal [-] of color face image processing-wrinkle ingredient with vector epsilon-filter" March, 1998 Institute of Electronics, Information and Communication Engineers synthesis convention proceedings, and D-11-143, and PP143 - reference -- things are known (it is hereafter called "skin vine"-ization). This is based on light-and-darkness change of small-size width, such as wrinkles and silverfish, being smoothed with the function which a two-dimensional epsilon-filter has and "which separates and oppresses the radio noise ingredient of the small-size width in a picture."

[0003]epsilon-filter (epsilon-separation nonlinear digital filter) is devised for the purpose of separation and removal of the radio noise ingredient of the small-size width

on which the signal wave form was overlapped from the first. In order to degrade it to the edge of a signal for the low pass filter (LPF) usually used for noise rejection not only to to oppress a noise component, but, when aimed at a picture, it had a fault which obscures the whole picture, but. epsilon-filter has the characteristic that the relation of the input signal and output signal carries out flattening only of the level variation of the small-size width in a signal wave form as shown in drawing 1.
since the edge accompanied by a steep level variation is saved also when it applies to a picture -- the picture whole -- going berserk -- it has the feature of hardly being spoiled.

[0004]The output signal y of a two-dimensional epsilon-filter (m, n) is expressed with (1) type when an input signal series is set to x (m, n).
[Equation 1]

$$y(m,\ n)=x(m,\ n)-\sum_{i}\sum_{j}a_{i,j}\cdot F(x(m,\ n)-x(m+i,n+j)) \qquad (1)$$

$a_{i \text{ and } j}$ are weighting factors, and if filter size is made into x (2M+1) (2N+1), they will fill (2) types here.
[Equation 2]

$$\sum_{i=-M}^{M}\sum_{j=-N}^{N}a_{i,j}=1 \qquad (2)$$

Function F(x) expressed with (1) type is a nonlinear function which is shown by the graph of drawing 2 and set to F(x)=0 in $|X|>epsilon_0$. In this specification, the value of this $epsilon_0$ will be called epsilon value.
[0005]Drawing 3 shows the fundamental composition of the two-dimensional epsilon-filter. The solid line frame shown with the numerals 1 in drawing 3 is a calculation part (it is also called a small-size width fluctuation-components calculation part) (among (1) type) of the radio noise ingredient u of small-size width (m, n). It is the 2nd paragraph of the right-hand side, and has the composition of acquiring the output signal series y (m, n) which oppressed the small-size width noise component by reducing the output from this calculation part from the input signal series x (m, n).
[0006]By applying this epsilon-filter to people's face picture, wrinkles and silverfish are removed and reduced and facial treatment-ization of a "skin vine vine" can be attained. Although neither wrinkles nor silverfish is what is called noises, it serves as light-and-darkness change of small-size width comparatively in the picture.
Light-and-darkness change of small-size width is smoothed by the oppression function of the small-size width level variation which epsilon-filter has, and wrinkles and silverfish can be made not conspicuous.
under the present circumstances -- since flattening only of the level variation of small-size width, such as wrinkles and silverfish, is carried out and steep level

variations, such as boundary parts, such as a pupil, an eyelid, and a supercilium, are saved -- the picture whole -- going berserk ---izing is attained, without hardly being spoiled "a skin vine."

[0007]Although the object of the formation of a "skin vine" is a skin field to the last, If the whole screen is uniformly processed with epsilon-filter, it will be oppressed to the small-size width level variation of a peripheral image, and the delicate light-and-darkness pattern which the hair of hair, clothes, a background, etc. have as a result will also be crushed, and it will be the picture by which an original detail and textures were spoiled.

[0008]Although this is a fatal thing in the field of the invention asked for advanced quality from the whole picture, such as television and a movie, "Skin vine"-ization can be attained without completely spoiling the detail of a peripheral image, and textures by making epsilon-filter act only on the complexion range of a picture selectively. For the purpose, what is necessary is just to apply the technique called the "chroma-key" (the technique of identifying the specific color areas in a picture electronically, and performing image processing, such as filtering, only to that field restrictively) which serves as a conventional means for many years in the technical field of television.

[0009]

[Problem(s) to be Solved by the Invention]As explained above, "skin vine"-ization with epsilon-filter has the possibility of the "electronic makeup" use in a teleplay, moviemaking, etc. However, if turned to practical use in this field as which high quality is required of the various whole request and picture over image processing, the following issues which should be solved occurred.

[0010]"Skin vine"-ization has the "rejuvenation" effect as image expressions in order to show a skin image sleekly. Although there is a point which is pointed out to the next and which should be improved when, as for this, an age actress performs her girlhood in the drama of a biography thing, etc., it is promising as the electronic makeup technique "rejuvenates skin" by image processing.

[0011]As mentioned above, it became clear for "skin vine"-ization to have been realized using epsilon-filter, but on the other hand, it is a teleplay, a movie, etc. and the electronic makeup technique in which the "it is "wrinkles emphasis when you become old and it performs role"" "become old" effect substantially exceeding real age is acquired is also called for. However, in the former, it was impossible to have realized "wrinkles emphasis" which can also be said to be an effect contrary to the formation of a "skin vine."

[0012]In "skin vine"-ization which uses epsilon-filter, the degree (strength) of the formation of a "skin vine" can be easily adjusted only by changing one parameter ($epsilon_0$ of drawing 2) according to the strength of wrinkles to hide or silverfish. however, the degree of the formation of a "skin vine" is strengthened -- it being alike and following -- the skin whole -- smoothly - although it becomes smooth, rather than

processing (texture) and textures of skin are lost and calling it "people's skin" -- "-- plus CHI@KKU ---like -- " -- it will be textures and will be a scarce picture of sincerity. If "skin vine"-ization is weakened in order to avoid this, although natural feeling will be recovered, there is dilemma that wrinkles and silverfish to hide above all will appear. That is, solution "to acquire the picture which left the texture and textures of skin, hiding wrinkles and silverfish to worry" is needed.

[0013]When it is assumed that above-mentioned "wrinkles emphasis" has been realized, it cannot only be overemphasized that he would like to acquire the picture by which "wrinkles emphasis" was carried out, maintaining the original state of the texture of "not only wrinkles emphasis" but skin.

[0014]There is the purpose of this invention in providing the image processing device which performs "skin vine"-ization, without spoiling the texture and textures of skin, and performs "wrinkles emphasis" further maintaining the original state of the texture of skin while realizing "wrinkles emphasis" which was conventionally unrealizable.

[0015]

[Means for Solving the Problem]To achieve the above objects, this invention image processing device, While being an image processing device which performs formation of a "skin vine", or "wrinkles" emphasis and impressing an input picture signal to an input terminal of epsilon-filter to an inputted image, A signal with which "wrinkles emphasis" of the input picture signal acquired by adding an output signal of a small-size width fluctuation-components calculation part of the epsilon-filter concerned to said input picture signal was carried out, "Skin vine" An input picture signal which is an output signal of the aforementioned epsilon-filter is characterized by a signal which turned constituting as an alternative or an extended epsilon-filter which is taken out simultaneously.

[0016]While impressing this invention image processing device to each input terminal of two epsilon-filters which have epsilon value which differs in size an input picture signal, "skin vine" size -- an output signal of epsilon-filter of epsilon value -- smallness -- by adding an output signal of a small-size width fluctuation-components calculation part of epsilon-filter of epsilon value, an input picture signal leaves texture and textures of skin, and is characterized by constituting so that it may be taken out as a signal which turned.

[0017]this invention image processing device -- an input picture signal -- size -- an extended epsilon-filter which has epsilon value -- smallness, while being impressed by each input terminal of epsilon-filter which has epsilon value, When correction instruction is "skin vine"-ization, by adding an output signal of a small-size width fluctuation-components calculation part of the aforementioned epsilon-filter to a "skin vine"-ized output signal of said extended epsilon-filter, "Skin vine" An input picture signal leaves texture and textures of skin, and them When correction instruction as a signal which turned is "wrinkles emphasis", By subtracting an output signal of a

small-size width fluctuation-components calculation part of the aforementioned epsilon-filter from a "wrinkles emphasis" output signal of said extended epsilon-filter, an inputted image maintaining the original state of texture of skin, it constituted so that it might be taken out as a signal by which "wrinkles emphasis" was carried out, respectively.

[0018]this invention image processing device makes arbitrarily amplitude value of two size which can be set up a parameter, By using a specific amplitude belt fluctuation-components separator digital filter (beta-filter) which separates selectively only fluctuation components which have the amplitude value inserted into the two amplitude value concerned, "Skin vine" An inputted image leaves texture and textures of skin, and a signal which turned, and a signal "wrinkles emphasis" was carried out by inputted image maintaining the original state of texture of skin are characterized by an alternative or constituting so that it may be taken out simultaneously.

[0019]

[Embodiment of the Invention]With reference to an accompanying drawing, this invention is explained in detail based on an embodiment of the invention below. Below, this invention is explained in order of the following.

(the filter by this invention which is realization of the formation of a "skin vine" and "wrinkles emphasis" which left the texture and textures of the realization (2) skin of 1) "wrinkles emphasis" and which can realize the formation of a "skin vine" and both the functions of "wrinkles emphasis" is called an extended epsilon-filter.

[0020]About the above (2), it shall realize by the three methods of a. to following c. further.

a.(1) Perform "skin vine"-ization which has natural feeling combining two epsilon-filters with which it is expressed by the formula.

b. Perform the formation of a "skin vine" and "wrinkles emphasis" which have natural feeling combining epsilon-filter and an extended epsilon-filter switchable.

c. Perform the formation of a "skin vine" and "wrinkles emphasis" which have natural feeling using the new digital filter provided by this invention.

[0021]First, realization of "wrinkles emphasis" of (1) is explained. Although it is difficult to newly make wrinkles at the place which does not have wrinkles, in this invention, a certain wrinkles are emphasized from the first by using the output of the small-size width fluctuation-components calculation part which is a component of epsilon-filter.

[0022]"Skin vine"-ization of the conventional skin asked for the small-size width fluctuation components of the input signal series by the small-size width fluctuation-components calculation part shown with the numerals 1 in epsilon-filter, and oppression of small-size width fluctuation components is realized by deducting this from an input signal series (refer to drawing 3).

[0023]Contrary to this, as shown in (3) types, small-size width fluctuation components,

such as wrinkles, can be emphasized by adding small-size width fluctuation components (the 2nd paragraph of the right-hand side of (3) types) to an input signal series (the 1st paragraph of the right-hand side) ("wrinkles emphasis"). However, since this addition (in-phase addition) result may deviate from the regulation level range (for example, 0-255) of a digital image, it needs the clip processing (processing which is restricted [with zero or less] to 0 255 with 255 or more) after addition.

[Equation 3]

$$y(m,\ n)=x(m,\ n)+\sum_{i}\ \sum_{j}a_{i,j}\cdot F(x(m,\ n)+x(m+i,n+j)) \qquad (3)$$

[0024]It is advantageous also in [it is more convenient to unite with the device for the formation of a "skin vine" which was conventionally realizable as a device which realizes this "wrinkles emphasis", and to have enabled it to use it for both, and] cost. As this unified circuitry, correction outputs, such as (a)"skin-vine "-izing, are set to one. (It is hereafter called "1 Outputted type"), carrying out firm output of the processing result of the formation of composition (b) "skin vine" and "wrinkles emphasis" which change the algorithm (or [subtracting] -- or does it add?) of the small-size width fluctuation components to an input signal according to the correction instruction (which of the formation of a "skin vine" and "wrinkles emphasis" is performed those directions) from the outside (hereafter) The necessity of calling it "being always an simultaneous operation output type" is accepted, and two kinds of gestalten, a gap or composition of enabling it to use one side, choosing, can be considered (any composition is called an extended epsilon-filter on these specifications).

[0025]A portion of a solid line frame which drawing 4 and drawing 5 show an example of 1 composition of this invention image processing device which performs formation of a "skin vine" and "wrinkles emphasis" with a gestalt corresponding to the above-mentioned (**) and (**), respectively, and is shown with the numerals 1 in both figures is a calculation part of the small-size width fluctuation components U (m, n). A correction instruction part shown with the numerals 2 in drawing 4 is a portion which directs whether you make which of formation of a "skin vine", and "wrinkles emphasis" carry out to the device concerned. Both devices are provided with a clipping circuit (Clip) for suppressing an addition (in-phase addition) result of small-size width fluctuation components for "wrinkles emphasis" to a regulation level range (for example, 0-255) of a digital image. [0026]Next, how (a method of above-mentioned (2) a.) to realize "skin vine"-ization which left texture and textures of skin of (2) combining two epsilon-filters with which it is expressed by (1) type is explained. First, it explains per principle. A change also has neither wrinkles nor silverfish in both texture of skin being the level variations (amplitude fluctuation) of small-size width comparatively. However, if wrinkles of a level, and silverfish and texture of skin to worry are compared, generally the amplitude fluctuation concerning texture is minuter. As a variable element

near amplitude fluctuation of texture, although what is called an image pick-up noise (noise) can be considered, an image pick-up noise may be disregarded in high definition image pick-up conditions in television or a movie. That is, the following relation among these is.

An amplitude fluctuation >> image pick-up noise of amplitude fluctuation > texture of wrinkles or silverfish [0027]By the way, if it processes with epsilon-filter expressed with (1) type by making small-size width value epsilonh appropriate to removal (formation of a "skin vine") of wrinkles or silverfish into epsilon value (refer to drawing 2), a level variation about texture will also be oppressed as a matter of course.

[0028]The minute amplitude fluctuation components u (m, n) produced by on the other hand processing minute amplitude value epsilonL (epsilonL<epsilonh) corresponding to amplitude fluctuation of texture of skin with epsilon-filter as an epsilon value (similarly refer to drawing 2).Since it is a level variation concerning texture and textures of skin, it is made to revive texture and textures of lost skin in conventional method by this invention using this from a principle of operation of epsilon-filter. [0029]"skin vine" "namely, -- it leaves texture of skin with the smaller range of fluctuation, removing" wrinkles and silverfish to worry (formation of a "skin vine") -- (**) -- change an original picture in small-size width value epsilonh with the epsilon-filter I (a texture ingredient is also oppressed in this case)

(**) This purpose is attained by adding a level fluctuation ingredient of minute amplitude divided into a processing result of formation of a "skin vine" of (**) (b) which separates a level fluctuation ingredient (texture ingredient) of minute amplitude from an original picture by minute amplitude value epsilonL by (**) with the epsilon-filter II. Drawing 6 shows an example of 1 composition of this invention image processing device which performs the above-mentioned signal processing.

[0030]Next, how to realize formation of a "skin vine" and "wrinkles emphasis" which have natural feeling combining the extended filter I and the epsilon-filter II which are the methods of above-mentioned (2) b. switchable is explained. Here, in formation of a "skin vine", about treatment of the minute amplitude fluctuation components u (m, n) obtained with the epsilon-filter II, texture and textures of skin lost conventionally are similarly revived by adding this to an output of the extended epsilon-filter I in a method of above-mentioned (2) a.

[0031]On the other hand, in "wrinkles emphasis", emphasis of texture by the minute amplitude fluctuation components u (m, n) which originally are not desirable is offset, and it is made to return to a level of the original texture.

[0032]that is, it emphasizes about significant wrinkles and silverfish, maintaining" the original state about texture of "skin -- (**) -- "wrinkles emphasis" of the original picture is carried out by small-size width value epsilonh with the extended epsilon-filter I (a texture ingredient is also emphasized in this case)

(**) This purpose is attained by subtracting a level variation ingredient of minute

amplitude separated from a processing result of "wrinkles emphasis" of (**) (b) which separates a level variation ingredient (texture ingredient) of minute amplitude from an original picture by minute amplitude value epsilonL by (**) with the epsilon-filter II.

[0033]Drawing 7 shows an example of 1 composition of this invention image processing device which performs "leaving texture of skin with the smaller range of fluctuation, removing wrinkles and silverfish to worry", and "emphasizing about significant wrinkles and silverfish, maintaining the original state about texture" to 2 person alternative. In drawing 7, a minute amplitude quality governing part shown with the numerals 3, Are a portion to carry out regulated treatment of minute amplitude fluctuation components, and with correction instruction of formation of a "skin vine", or "wrinkles emphasis." It is a portion which performs an algorithm (it will subtract if it is "skin vine"-ization and is addition and "wrinkles emphasis") of minute amplitude fluctuation-components u_2 (m, n) separated with the epsilon-filter II to output y_1 (m, n) of the extended epsilon-filter I. In this case, although the extended epsilon-filter I performs formation of a "skin vine", or "wrinkles emphasis" according to correction instruction, it was already explained with reference to drawing 6 about this.

[0034]Next, how to realize formation of a "skin vine" and "wrinkles emphasis" which are the methods of (2) c. mentioned above and which have natural feeling using a new digital filter provided by this invention is explained. First, it reviews about a case where "skin vine"-ization which has natural feeling combining the two methods of above-mentioned (2) a., i.e., epsilon-filter with which it is expressed by (1) type, is performed. In this case, it is performed by composition of drawing 6 as mentioned above.

[0035]It is expressed with (4) types when signal processing performed by the composition of drawing 6 is expressed with expression. (4) the first paragraph of the right-hand side surrounded and shown by a curly brace in a formula -- an operation (formation of a "skin vine" by epsilon=epsilon h) of the epsilon-filter I -- the second following paragraph of the right-hand side shows an operation (separation of fluctuation components below amplitude epsilonL "involved in texture") of the epsilon-filter II, respectively.

[Equation 4]

$$y(m,\ n) = \{x(m,\ n) - \sum_{i}\sum_{j} a_{i,j} \cdot F_{\varepsilon h}(x(m,\ n) - x(m+i,\ n+j))\} + \sum_{i}\sum_{j} a_{i,j} \cdot F_{\varepsilon L}(x(m,\ n) - x(m+i,\ n+j)) \qquad (4)$$

Now and (4) types, [External Character 1]

$$\sum_{i}\sum_{j} a_{i,j}$$

It is alike, and its attention is paid, and it will become (5) types if it arranges. [Equation 5]

$$y(m,\ n)=x(m,\ n)-\sum_{i}\sum_{j}a_{i,j}\cdot\{F_{\varepsilon h}(x(m,\ n)-x(m+i,n+j))$$

$$-F_{\varepsilon L}(x(m,\ n)-x(m+i,n+j))\}\qquad(5)$$

[0036]$F_{epsilon}(x)$ (refer to drawing 2) becomes the same value here to x |X|<=epsilon Becoming, Since it is a function then set to 0 other than this, $F_{epsilonh}$ of (5) types (**x), $F_{epsilonL}$ (**x) is at the time of |deltax|<=epsilonL, respectively. At the time of $F_{epsilonh}$(**x) =deltax and $F_{epsilonL}$(**x) =deltaxepsilonL<|deltax|<=epsilonh. At the time of $F_{epsilonh}$(**x) =deltax and $F_{epsilonL}$(**x) =0epsilonL<|deltax| It is set to $F_{epsilonh}$(**x) =0 and $F_{epsilonL}$(**x) =0. therefore -- as opposed to fluctuation-components **x contained in the amplitude belt with which the whole portion expressed with {$F_{epsilonh}$(**x)-$F_{epsilonL}$ (**x)} in (5) types is set to epsilonL<|**x|<=epsilonh -- the same value -- other than this -- coming out -- it has the characteristic which outputs 0.

[0037]This characteristic is the characteristic (it is considered as phibetaL and betah(X)) of a new nonlinear function specified by two parameter betaL as shown in drawing 8, and betah itself. (5) types are rewritten like (6) types by using this new nonlinear function phibetaL and betah(X).

[Equation 6]

$$y(m,\ n)=x(m,\ n)-\sum_{i}\sum_{j}a_{i,j}\cdot\phi_{\beta L,\beta h}(x(m,\ n)-x(m+i,n+j))\qquad(6)$$

[0038]That is, (6) types show the characteristic of the new nonlinear digital filter (it is hereafter called a specific amplitude belt fluctuation-components discrete type digital filter (or beta-filter)) separating and oppressing only the fluctuation components of a specific amplitude belt using the new nonlinear function phibetaL and betah(X). And that function is completely the same as the function by what combined two epsilon-filters shown in drawing 6 so that it may understand also from this (6) type having been drawn from (4) types. Therefore, "skin vine"-ization which left the textures of skin can be attained at once by this one beta filter.

[0039]beta-filter the same with having realized an extended epsilon-filter by adding composition which adds small-size width fluctuation components divided into the conventional epsilon-filter output with epsilon-filter to an input picture signal, an oppression function (formation of a "skin vine") of separated specific amplitude belt fluctuation components -- in addition, the emphasis function ("wrinkles emphasis") can also be made to have As shown in drawing 9, by this beta-filter, as opposed to quality formation of a "skin vine" and "wrinkles emphasis" in consideration of texture of skin -- one piece

-- correspondence -- being possible (in composition of drawing 7, two pieces, the extended epsilon-filter I and the epsilon-filter II, were needed) -- it becomes an "electronic makeup" device which becomes, therefore produces a natural processing result with simple composition.

[0040]Also in fundamental composition of this invention image processing device using a specific amplitude belt fluctuation-components discrete type filter (beta-filter), Like an example of composition of an extended epsilon-filter which added a function to emphasize small-size width fluctuation components to composition of the conventional epsilon-filter, (**) composition "1 output type" which sets correction outputs, such as formation of a "skin vine", to one, and changes an algorithm (or [subtracting] -- or does it add?) of specific amplitude belt fluctuation components to an input signal according to correction instruction (which of formation of a "skin vine" and "wrinkles emphasis" is performed those directions) from the outside

(b) Firm output of the processing result of "wrinkles emphasis" is carried out to "skin vine"-ization, necessity is accepted and two kinds of gestalten, a gap or composition "it is always an simultaneous operation output type" of enabling it to use one side, choosing, can be considered.

[0041]A portion of a solid line frame which drawing 10 and drawing 11 show an example of 1 composition of this invention image processing device which performs formation of a "skin vine" and "wrinkles emphasis" with a gestalt corresponding to the above-mentioned (a) and (b) with beta-filter, respectively, and is shown with the numerals 4 in both figures is a specific amplitude belt fluctuation-components calculation part. Also in these both devices (drawing 10, drawing 11), it has a clipping circuit (Clip) for suppressing an addition (in-phase addition) result of specific amplitude belt fluctuation components for "wrinkles emphasis" to a regulation level range (for example, 0-255) of a digital image.

[0042]beta-filter provided by this invention is explained further. The function phibetaL used as a base of beta-filter and betah(X) act only to level fluctuation (phibetaL<=|X|<=betah) which has the two amplitude value phibetaL and the amplitude value inserted into betah(X), and are characterized by being a nonlinear function which does not involve about about zero minute amplitude change. Although both this function phibetaL, betah(X), and nonlinear function F(X) of the conventional epsilon-filter shown in drawing 2 specify requirements for a filter in an amplitude domain of level fluctuation, each [in / in an essential difference in a function surface of both functions of phibetaL, betah(X), and F(X) / a frequency domain] -- dummy treatment ****** is made to a difference between a band pass filter (BPF) and a low pass filter (LPF).

[0043]That is, only level fluctuation included in a certain specific amplitude belt in an input signal series which consists of level fluctuation of various amplitude by introduction of this nonlinear function phibetaL and betah(X) is separated selectively,

and a digital filter which can be oppressed or emphasized is produced.

[0044]As it explained with reference to literature in conventional technology, an "epsilon-filter is a filter devised for the purpose of noise rejection of small-size width from the first. When it aims at noise rejection, in examining shape of a nonlinear function to be used, a function of a gestalt as shown in drawing 8 becomes outside of an object of consideration. In noise rejection, it is because it cannot say that it removes and it is saved for removal about a minuter change although noise of a certain amplitude belt is made applicable to removal. Therefore, it is prescribed by this nonlinear function and this function, and a digital filter provided by this invention is borne by completely different the purpose and the way of thinking from the former, and enables new application in each field.

[0045]Finally by combining this beta-filter and a color region decision circuit. Image processing which depends in consideration of texture of skin and performs quality formation of a "skin vine" or "wrinkles emphasis" becomes possible [holding surrounding detail and textures], and this demonstrates much more validity as an "electronic makeup" device in a field of television, a movie, etc.

[0046]Drawing 12 shows an example of 1 composition of an "electronic makeup" device which consists of such composition. In drawing 12, a specific color region specified with a parameter in an input picture signal in the color region decision circuit 5 is judged, Only in the judged color region, the output y of beta-filter (m, n) is taken out as an output signal, and in a field which is not so, the change-over switch 6 is controlled by an output of the color region decision circuit 5 so that an input picture signal is outputted as it is.

[0047]As explained above, this invention image display device, Although formation of a "skin vine" and "wrinkles emphasis" which perform "wrinkles emphasis" and have natural feeling more by amending an input picture signal series as a two-dimensional picture using a specific amplitude fluctuation segregation function of beta-filter by small-size width fluctuation-components isolation and this invention of epsilon-filter are performed, a view of weakening or emphasizing this while separating small-size width fluctuation components and specific amplitude belt fluctuation components in an input signal which is a basic principle of this invention can be applied to processing of a one-dimensional signal as what is called a time series signal -- it is natural.

[0048]

[Effect of the Invention]According to this invention, the "rejuvenation" which has natural feeling as image expressions in television or a movie, and the effect of "becoming old" become possible by image processing in natural more.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The relation between an input signal and an output signal shows the characteristic of epsilon-filter.

[Drawing 2]The graph shows nonlinear function F(X) used with epsilon-filter.

[Drawing 3]The fundamental composition of the two-dimensional epsilon-filter is shown.

[Drawing 4]The example of 1 composition of this invention image processing device which performs formation of a "skin vine" and "wrinkles emphasis" with "1 output type" is shown.

[Drawing 5]The example of 1 composition of this invention image processing device which performs formation of a "skin vine" and "wrinkles emphasis" by "it is always an simultaneous operation output type" is shown.

[Drawing 6]The example of 1 composition of this invention image processing device "which leaves the texture of skin with the smaller range of fluctuation removing wrinkles and silverfish to worry" and which was made like is shown.

[Drawing 7]The example of 1 composition of this invention image processing device which performs "leaving the texture of skin with the smaller range of fluctuation, removing wrinkles and silverfish to worry" and "emphasizing about significant wrinkles and silverfish, maintaining the original state about texture" to 2 person alternative is shown.

[Drawing 8]The graph shows the nonlinear function phibetaL and betah(X) which specify the new digital filter (beta-filter) provided by this invention.

[Drawing 9]By using beta-filter shows that correspondence becomes possible with one filter (beta-filter) performing formation in consideration of the texture of skin of quality "skin vine", and "wrinkles emphasis."

[Drawing 10]The example of 1 composition of this invention image processing device which performs formation of a "skin vine" and "wrinkles emphasis" with "1 output type" beta-filter is shown.

[Drawing 11]The example of 1 composition of this invention image processing device which performs formation of a "skin vine" and "wrinkles emphasis" with beta-filter of "being always an simultaneous operation output type" is shown.

[Drawing 12]The example of 1 composition of the "electronic makeup" device constituted combining beta-filter and the color region decision circuit is shown.

[Description of Notations]

1 Small-size width fluctuation-components (noise component) calculation part

2 Correction instruction part

3 Minute amplitude quality governing part

4 Specific amplitude belt fluctuation-components calculation part

5 Color region judgment part

6 Change-over switch